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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/834,791	04/13/2001	Sindo Kou	032026:0546	8377

7590 07/23/2002

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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 07/23/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/834,791	KOU ET AL.	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-37* is/are pending in the application.

4a) Of the above claim(s) *1-12* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *13-37* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 April 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *3* .
4) ☐ Interview Summary (PTO-413) Paper No(s) _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Invention II in Paper No. 5 is acknowledged. The traversal is on the ground(s) that the method and apparatus claims are closely related. This is not found persuasive because a serious burden exists in the differing issues is likely to arise during the prosecution of the different statutory classes of the invention. The requirement is still deemed proper and is therefore made FINAL.

2. Claims 1-12 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 5.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 21 and 37 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as

the invention. Claim 21 cites the limitation of "thoroughly mixing", it is unclear how "thoroughly" mixing differs from generic mixing, likewise for claim 37.

5. Claims 13-37 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 13 cites the limitation of "desired concentration" in line 4, it is unclear how desired is limiting and it is suggested by the examiner that "desired" is deleted, likewise for the claims 14-37.

6. Claim 26 and 36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 26 cites the limitation of "desired dopant" in line 3, it is unclear how desired is limiting and it is suggested by the examiner that "desired" is deleted, likewise for claim 36.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 13-14, 21-24 and 27-28, as interpreted by the examiner, are rejected under 35 U.S.C. 102(b) as being anticipated by Kobayashi et al. (US 5,363,796).

In a method of growing single crystals, Kobayashi et al. discloses a double structure crucible with a crucible made of quartz placed inside a graphite crucible (col 7, ln 10-18). Kobayashi et al also discloses a main heater (32) and a subheater (33) facing the zone in which the crucible vertically moves and are vertically separated (col 7, ln 19-30) at the lower and upper portions of the periphery of the crucible (col 5, ln 27-35). Kobayashi also teaches a melt layer (L) above a solid layer where a single crystal is pulled up from the melt layer and the crucible is lifted, such that the positional relationship between the crucible and the main heater (32) changes hence the solid layer melts. Kobayashi et al also teaches that a wire (6), which can be raised and lowered and rotated is hung from the top of a pull chamber, where a seed is fixed to the lower end of the pulling shaft (6) and a single crystal grows from said seed (col 6, ln 56-64). Kobayashi et al. also teaches a raw material is charged into said crucible in an Argon (Ar) atmosphere and the main heater and subheater are activated so that all of the raw material is melt, then the output of the main heater is increased and the power of the subheater is decreased to grow the solid layer in the lower portion of the crucible, where after the solid layer becomes stable and stops growing, a N-type dopant is added (col 9, ln 10-25). Kobayashi et al also discloses the lower end of the seed is immersed into the melted layer and the single crystal is pulled up while rotating the crucible and wire (col 13, ln 5-11). Kobayashi et al also discloses the subheater **33** may be powered on in the process of pulling the single crystal in order to increase the melting rate (col 12, ln 59-67). Kobayashi et al also discloses the powers of the main heater and subheater are

changed after the neck and shoulder portions of he single crystal are formed, where the main heater power is lowered and subheater power is increased (col 13, ln 12-20 and Fig 9).

Referring to claim 14, Kobayashi et al discloses the wire (6) rotates.

Referring to claim 21, as interpreted by the examiner, Kobayashi et al discloses a crucible filled with a solid raw material is melted by the upper and lower heaters and turning off the lower heater to form a solid in the lower portion of the crucible while maintaining the upper portion at a temperature above the melt temperature of the feed material. Kobayashi et al teaches melting the feed material, it is inherent to Kobayashi et al's invention to mix the feed material prior to freezing the feed material because the temperature of the melt results in convection mixing.

Referring to claim 22, Kobayashi et al discloses the lower end of the seed is immersed into the melted layer and the single crystal is pulled up while rotating the crucible and wire.

Referring to claim 23, Kobayashi et al discloses the power of the main heater is lowered after the formation of the neck and shoulder portions of the single crystal.

Referring to claim 24, Kobayashi et al disclose the power of the lower heater is raised after the formation of the neck and shoulder portions.

Referring to claim 27, Kobayashi et al discloses an Argon atmosphere.

Referring to claim 28, Kobayashi et al discloses an upper heater and a lower heater operating independently to form a melt and a solid layer as applicant, therefore, it is inherent to Kobayashi et al's invention to maintain a temperature gradient in the melt to enhance convection mixing of the melt.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 15-19, 29-35 and 37, as interpreted by the examiner, are rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 5,363,796) in view of Morioka et al (US 4,609,530).

Kobayashi et al teaches all of the limitations of claim 15, as discussed previously in claim 13, except covering the melt with a liquid encapsulant material while growing the crystal from the melt and drawing the growing crystal out of the melt.

In a method of growing a GaAs single crystal with an Indium (In) impurity, Morioka et al teaches a crucible containing a GaAs raw material melt containing an impurity of Indium and encapsulated with a liquid encapsulating layer of B_2O_3 to prevent the dissipation of As (col 11, ln 20-30). Morioka et al also teaches a seed crystal is dipped in the GaAs melt and an upper shaft is pulled upwardly in a liquid encapsulated Czochralski (LEC) method (col 11, ln 30-40). Morioka et al also teaches a GaAs polycrystal not containing In is prepared in the crucible and In or InAs is added to the polycrystal melt, where the addition of In read's on applicant's In-doped GaAs feed material and the addition of InAs reads on applicant's alloy of InAs-GaAs feed material (col 12, ln 10-30).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kobayashi et al with Morioka et al because the liquid encapsulant prevents the dissipation of Arsenic (As) when growing a GaAs single crystal doped with Indium (In).

Referring to claim 16, the combination of Kobayashi et al and Morioka et al teaches an In-doped GaAs feed material.

Referring to claim 17, the combination of Kobayashi et al and Morioka et al teaches a B_2O_3 liquid encapsulant.

Referring to claim 18, the combination of Kobayashi et al and Morioka et al teaches an alloy of InAs-GaAs as the feed material.

Referring to claim 19, the combination of Kobayashi et al and Morioka et al teaches a liquid encapsulant of B_2O_3.

Referring to claim 29, the combination of Kobayashi et al and Morioka et al teaches a crucible with a solid feed material having a desired concentration of constituents for the crystal to be grown, an upper heater, which heats an upper portion of a crucible to melt a feed material, a lower heater for heating a lower portion of a crucible to a lower temperature below the melt temperature of the feed material, a liquid encapsulant covering the melt and advancing the crucible with respect to the heaters to melt portions of the solid feed material to replace the material drawn from the melt.

Referring to claim 30, the combination of Kobayashi et al and Morioka et al teaches rotating the crystal as it is drawn from the melt.

Referring to claim 31, the combination of Kobayashi et al and Morioka et al teaches a feed material of In-doped GaAs.

Referring to claim 32, the combination of Kobayashi et al and Morioka et al teaches a liquid encapsulant of B_2O_3.

Referring to claim 33, the combination of Kobayashi et al and Morioka et al teaches an alloy of InAs-GaAs as a feed material.

Referring to claim 34, the combination of Kobayashi et al and Morioka et al teaches a liquid encapsulant of B_2O_3.

Referring to claim 35, the combination of Kobayashi et al and Morioka et al teaches the lower end of the seed is immersed into the melted layer and the single crystal is pulled up while rotating the crucible and wire.

Referring to claim 37, as interpreted by the examiner, the combination of Kobayashi et al and Morioka et al teaches a crucible with a solid feed material is melted by an upper and lower heater and turning off the lower heater to form a solid in the lower portion of the crucible and heating an upper portion to temperature above the melting temperature of the feed material. It is inherent to Kobayashi et al's invention to mix the feed material prior to freezing the feed material because Kobayashi et al teaches melting the feed material, where the temperature of the melt results in convection mixing.

11. Claim 20, as interpreted by the examiner, is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 5,363,796) in view of Abrosimov et al (DE 19615991 A1), an abstract of Abrosimov et al has been provided.

Kobayashi et al discloses all of the limitations of claim 20, as discussed previously in claim 13, except the feed material is SiGe.

In a method of growing a mixed crystal, Abrosimov et al teaches a process for pulling a SiGe mixed crystal by the Czochralski method, where a SiGe crystal is pulled from a SiGe melt

and SiGe mixed crystals are used in microelectronics and opto-electronics (Derwent Abstract of DE 19615991 A1 and Fig 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kobayashi et al with Abrosimov et al because it forms a SiGe mixed crystal useful in microelectronics.

12. Claim 25-26, as interpreted by the examiner, are rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 5,363,796) in view of Lin et al (Journal of Crystal Growth 193 (1998) pg 443-445).

Kobayashi et al teaches all of the limitations of claim 25, except the speed at which the crucible is advanced with respect to the heater is $V_c=V_s(d_s/d_c)^2$.

In a method of pulling a Cd-doped InSb single crystals from a molten zone on a solid feed, Lin et al teaches a mass balance on the melt, $D_c=D_f(V_f/V_c)^{0.5}$, where V_f is the crucible raising speed, i.e. V_c, Vc is the crystal pulling speed, i.e. V_s, D_c is the crystal diameter, i.e. d_s and D_f is the feed diameter, i.e. d_c. (Equation 1 and pg 445, col 2), where solving the equation for V_c, yields $V_c=V_s(d_s/d_c)^2$. Lin et al also teaches most dopants have a segregation coefficient k and tend to segregate significantly during crystal growth and a pulled crystal of a uniform dopant concentration of C_o from a molten zone which was predoped to C_o/k (pg 443, col 1).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kobayashi et al with Lin et al's speed at which the crucible is advanced with respect to the heaters because it maintains the melt at steady state (pg 443,col 2).

Referring to claim 26, the combination of Kobayashi et al and Lin et al teaches a melt concentration of C_o/k, where C_o is the concentration of the pulled crystal reduced segregation in the pulled single crystal (pg 445, col 2).

13. Claim 36, as interpreted by the examiner, is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 5,363,796) in view of Morioka et al (US 4,609,530) as applied to claims 29-35 above, and further in view of Lin et al (Journal of Crystal Growth 193 (1998) pg 443-445).

The combination of Kobayashi et al and Morioka et al teaches all of the limitations of claim 36, as discussed previously in claim 29, except the addition of a desired dopant to adjust the melt concentration to a level C_o/k, where C_o is the desired dopant concentration in the crystal and k is an experimentally determined constant.

In a method of pulling Cd-doped InSb single crystals from a molten zone on a solid feed, Lin et al teaches most dopants have a segregation coefficient k and tend to segregate significantly during crystal growth and a pulled crystal of a uniform dopant concentration of C_o from a molten zone which was predoped to C_o/k (pg 443, col 1). Lin et al also teaches effective segregation reduction was obtained in a Cd-doped InSb single crystal pulled from a predoped molten zone (pg 445, col 2). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kobayashi et al and Morioka et al with Lin et al's melt with a dopant concentration of C_o/k because a single crystal with reduced segregation is produced.

14. Claim 21, as interpreted by the examiner, is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 5,363,796) as applied to claims 13 and 21 above, and further in view of Van Uitert et al (US 4,013,501).

Kobayashi et al teaches all of the limitations of claim 21, as discussed previously in claim 21, except if it is not inherent to Kobayashi et al to thoroughly mix the melted material.

In a method of growing neodymium doped yttrium aluminum garnet crystal, Van Uitert et al teaches a mixture is heated in a platinum crucible to a temperature on the order of 1300°C and held at this temperature for a period of time such as 24 hours to ensure complete solution of crystal components and uniformity of the melt, this reads on applicant's thoroughly mixing, and mixing of constituents is enhanced by rotating the crucible, the direction of rotation being reversed periodically (col 2, ln 35-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kobayashi et al with Van Uitert et al heating and rotating to ensure uniformity in the melt.

15. Claim 37, as interpreted by the examiner, is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 5,363,796) in view of Morioka et al (US 4,609,530) as applied to claims 29-35 and 37 above, and further in view of Van Uitert et al (US 4,013,501).

The combination of Kobayashi et al and Morioka et al teaches all of the limitations of claim 37, as discussed previously in claim 37, except if it is not inherent to the combination of Kobayashi et al and Morioka et al to thoroughly mix the melted material.

In a method of growing neodymium doped yttrium aluminum garnet crystal, Van Uitert et al teaches a mixture is heated in a platinum crucible to a temperature on the order of 1300°C

and held at this temperature for a period of time such as 24 hours to ensure complete solution of crystal components and uniformity of the melt, this reads on applicant's thoroughly mixing, and mixing of constituents is enhanced by rotating the crucible, the direction of rotation being reversed periodically (col 2, ln 35-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kobayashi et al and Morioka et al with Van Uitert et al's heating and rotating to ensure uniformity in the melt.

Conclusion

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

mjs
July 9, 2002

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